**6 Diseases Back from the Dead**

Plague, TB, and measles seem like illnesses of the history books or infections beaten back by modern science. But once-vanquished diseases are now reemerging all over the world. Here's why. By Stephanie Warren

<http://www.popularmechanics.com/science/health/genetics/6-diseases-back-from-the-dead#fbIndex1>

### THE PLAGUE The [Black Death](http://www.d.umn.edu/cla/faculty/tbacig/hmcl1005/plague/) struck Europe in 1348. Just five years later, a third of the population—50 million people—was dead. And though plague seems like an illness of another time—that it belongs to a day when a victim was treated with a healthy bloodletting and a garlic-onion-butter poultice—it's still with us today. Small outbreaks of plague can swiftly strike a few hundred people before they can be stopped. Researchers are trying to figure out why the disease was so deadly in the Middle Ages, and how it's causing harm once again. To answer the first part of that question, scientists from McMaster University in Hamilton, Ontario, recently sequenced the genome of the bacterium responsible for the Black Death. They drilled into the soft tooth tissue of four victims recovered from a London Black Death gravesite called East Smithfield, and got enough DNA fragments to map the killer's full genome for [a study in Nature](http://www.nature.com/doifinder/10.1038/nature10549). What they found was very strange. Since outbreaks of the modern plague, while scary, are nowhere near as devastating as the Black Death, researchers thought the modern plague would show significant changes in its DNA when compared to the ancient one. But instead, today's plague is barely different from its centuries-old ancestor. The factors that probably made medieval plague outbreaks so severe include the unsanitary living conditions of those days, and perhaps a population that was genetically predisposed to being more sensitive to the disease. But paper co-author Kirsten Bos says, all these years later, scientists don't have the full picture. "We can't explain why we saw that cataclysmic mortality." Plague is primarily transmitted to humans by fleas that live on rodents. Modern plague outbreaks have occurred in California, New Mexico, Arizona, and Colorado, where wild rodents carry the disease. Other hot spots for modern plague outbreaks include South American countries such as Ecuador and Peru, and parts of Africa and Asia. Most of these outbreaks take the form of bubonic plague—a type that causes grossly swollen lymph nodes. Because it's easily treatable with antibiotics, this kind is the least deadly. But the other forms of plague—septecemic, which infects the blood, and pnemonic, which strikes the lungs—are much worse. Pnemonic plague spreads directly from person to person, and attacks so quickly that patients can die before antibiotics take effect. Without early treatment, pnemonic plague's death rate is nearly 100 percent. "If you have an outbreak of pnemonic plague, that is going to be bad news for that community," says Juan Olano, M.D., an infectious disease expert at the University of Texas. So far authorities have been able to contain plague outbreaks. But some diseases don't stay confined.

**LEPSPIROSIS**  In 2000, 304 men and women in peak physical shape landed in Malaysia for the adventure of a lifetime. They trekked through jungles, mountains, and rivers to compete for the top spot in the Echo Challenge, a multiday adventure race called the toughest endurance event in the world. When they boarded the plane for the return trip, 29 of them unknowingly carried a dangerous bacteria called Leptospira, and [fell mysteriously ill](http://wwwnc.cdc.gov/eid/article/9/6/02-0751_article.htm) when they got home.

Leptospira lives in many mammal species. It enters water sources through infected animals' urine, and it can pass to humans if they swallow infected water or if it enters through a skin wound—something the battle-scarred athletes had in excess. The infected athletes were hospitalized for fever, nausea, and vomiting before doctors figured out what was wrong with them; luckily, none died. Outbreaks, however, continue to occur worldwide—in the U.S., the disease usually shows up in people who have recently traveled.

Diseases move at the speed of their hosts. As we become increasingly globalized, we give the bugs a big advantage: They can zip from place to place as fast as a jetliner. "You can travel from London to New York and carry with you an infection that you don'teven know you have," says David Heymann, chairman of the U.K.'s Health Protection Agency.

Human hosts aren't the only thing infectious bacteria can hitch a ride on. "Mosquitoes are carrying infections around the world," Heymann says, so much so that they've inspired the term "Airport Malaria" (the disease-laden insects hitch a ride on a plane). When they deboard in their new location, they can infect someone even if that person has never left the country. Airport Malaria has become a problem in nearly every country, Heymann says, and leptospirosis and malaria aren't the only diseases that have become increasingly dangerous because of our globe-trotting lifestyle.

**DENGUE FEVER** In the 1960s, health authorities thought they could finally breathe a sigh of relief. Through mosquito-control efforts, they had nearly eliminated dengue fever, a viral disease [found in the tropics](http://www.washingtonpost.com/wp-dyn/content/article/2007/05/04/AR2007050400763.html). Suddenly in the '70s, it began to reappear. Outbreaks started cropping up across Latin America, and they just got worse. In 1998, there was a pandemic of dengue fever and its much more severe cousin, dengue hemorrhagic fever. More than a million cases were reported in 56 countries; now, more than 100 million cases occur every year.

Most people with dengue fever don't have symptoms. The virus simply uses them as carriers. When the disease finally strikes, it starts as a sudden fever, often as high as 104, 105 degrees. Two to five days later, the victim is covered with a red rash, accompanied by headache, fatigue, vomiting, and joint and muscle aches. Most people recover, but a small number of dengue fever cases develop into dengue hemorrhagic fever, which starts out like dengue fever but then causes a shock phase that kills half its victims. There is no cure for dengue fever, and no vaccine to prevent it.

Dengue used to be a disease of poorer areas, Heymann says. But in India, for example, it became a middle-class disease when mosquitoes bred in the air-cooling systems of peoples' houses, causing major outbreaks. "Anywhere there are mosquitoes that can transmit a disease, they'll transmit it," says Heymann. And the age of air travel means that the range of diseases like dengue has become huge. "It's really interesting to follow dengue as it has spread throughout the world," Heymann says.

**TUBERCULOSIS** Tuberculosis has been a scourge of humanity for thousands of years. Experts think that even ancient Egyptians had it, judging from the skeletal abnormalities of certain mummies. TB is a bacterial lung infection transmitted through the cough or sneeze of an infected person. At one point in history, it was called consumption because of how it causes its victims to waste away. It spread unchecked in places where people lived very close together in unsanitary conditions, such as tenements. At the turn of the 20th century, it was the leading cause of death in the United States. As living conditions improved, TB retreated. But not forever.

When AIDS appeared in force in the United States in the 1980s, TB suddenly reemerged. It happened because AIDS attacks the body's immune system, creating a window of opportunity for TB. "AIDS was rampant during the '80s and '90s," Olano says. "Patients were dying right and left, the medication was expensive and not available to everybody, and tuberculosis went up with it."

Because of this piggybacking effect, TB is now a big problem in sub-Saharan Africa, where AIDS killed 1.3 million people in 2009 alone. CDC expert Dr. Philip LoBue says that in some sub-Saharan African countries, it's not unusual for 50 or 60 percent of patients with TB [to also have AIDS](http://www.cdc.gov/hiv/resources/factsheets/hivtb.htm).

And as TB has reemerged, the virus has gained antibiotic resistance, too. Treating TB is a long and complicated ordeal, in which patients get a cocktail of least four drugs for at least six months. But in countries with poor public health resources, the full treatment might not be available. And if the patient only takes one TB drug, those bacteria that have mutated immunity to it survive and spread. Today doctors are facing tuberculosis that is resistant to multiple antibiotics. Treating these infections successfully can take as long as two years, and the second-line drugs that have to be used have unpleasant side effects.

"We don't have too many new medications to treat tuberculosis," says Olano. "The last great discovery was in the late '60s." Tuberculosis is just one of diseases facing this problem—there are now strains of malaria that are also multidrug resistant, and even once easily-treatable infections like gonorrhea are becoming more and more difficult to get rid of. The only real solution, says Heymann, is to create vaccines. But for many diseases, those are likely far off.

**MEASLES** Some diseases are showing up again because they've become resistant to the drugs we use to treat them. Others are easily preventable, but are coming back anyway because of the new wave of antivaccination fears.

Measles is so contagious that if you're in the same room with someone sick with it, there's a 90 to 95 percent chance that you'll get the virus too. It was once so common that nearly everyone became sick with it by age 20. Measles can be potentially serious, especially for children and the elderly because it can make them susceptible to pneumonia.

A measles vaccine was introduced in 1963, and the number of cases rapidly dropped until the disease was basically eliminated in the U.S. and other developed countries. But in the last few years, small outbreaks numbering in the tens or hundreds have begun to crop up again. Most begin in a child whose parents have refused the modern vaccination, MMR, which also protects against mumps and rubella. These growing outbreaks are frightening because childhood diseases like measles and pertussis, or whooping cough, can infect not only unvaccinated children but also adults, especially elderly adults. Our immunity to diseases we've been vaccinated against, says Olano, starts to drop at around age 20. "That's why these outbreaks have the potential to become a public health nightmare."

Some people fear that vaccines for measles and other childhood diseases cause autism, a fear that stems from a [now-retracted paper](http://press.thelancet.com/wakefieldretraction.pdf) published in the journal *The Lancet* in 1998. "The analysis was horrible, the data was manipulated, and the connection was not there," Olano says. "But now to go back to people and convince them that there is no connection is impossible." Numerous studies in the years since have found no connection between the vaccine and autism. Yet the fear persists, and the outbreaks climb.

**TYPHOID** Scientists working at a hospital in central Kathmandu, Nepal, recently came up with a novel approach to try to contain re-emerging disease. The researchers used Google Maps [to track an outbreak of typhoid](http://www.ox.ac.uk/media/news_stories/2011/111018.html) in the area. They went to each infected person's house and mapped his or her location using GPS. Then they analyzed the genotype of the typhoid bacteria from each patient. Since typhoid, like other diseases, evolves as it spreads, the researchers could use the combination of DNA mapping and geographic mapping to see exactly how the disease moved through the population.

What they found came as a complete surprise. "The belief is that it's transmitted directly between people," says Stephen Baker, the lead author of the study published in *Open Biology*. Baker was expecting to find that people living in the same household or who otherwise had direct contact with each other would all carry the same variety of typhoid. But instead, "it was more or less random," he says. This means that the person-to-person transmission that scientists have always thought was a main way the disease spread simply isn't that critical.

Typhoid, which comes from water contaminated with infected human feces, was widespread across Europe until the turn of the 20th century. As public health and infrastructure improved, and living conditions became more sanitary, it was all but eliminated in most of Europe and the United States. But huge population growths in developing countries resulted in dense populations living in unhygienic conditions, and now typhoid infects 21.5 million people a year. "What's happened is that even as it's reemerging in densely populated parts of South Asia, the infrastructure can't cope," says Baker. "It's like adding fuel to the fire."

Because the researchers now know that typhoid spreads almost exclusively through contact with contaminated water—and not from person to person—they can focus resources on cleaning up infected areas rather than trying to distribute vaccines. "Vaccines are important, but they're only part of the story," Baker says. "What this means is that if we invest a lot of money in vaccinating people in the short term that won't have any long-term effect."

**FOOD FOR THOUGHT:**

1. **Explain how innovations in science, and any other areas, are preventing these diseases from achieving the mortality rates they previously accomplished. (Understanding level)**
2. **Of these recurring diseases, which one leaves you the most concerned? Why? (Analysis level)**
3. **In your opinion, should some of the billions of dollars invested into AIDS or cancer research be funneled into any of these newly-recurring diseases? Explain why or why not, using support from the article to support your assertion. (Evaluation level)**